

FIG. 1

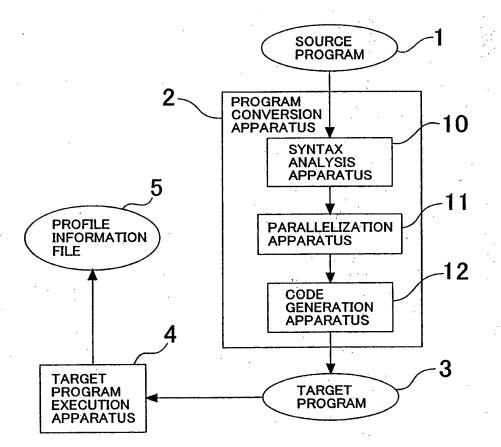


FIG. 2

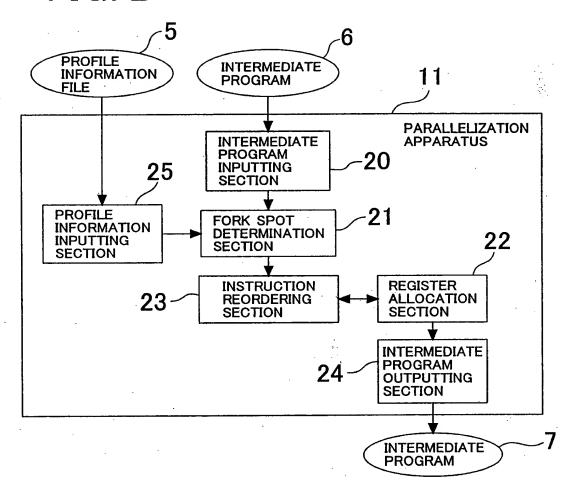


FIG. 3

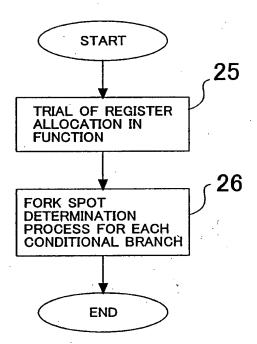


FIG. 5

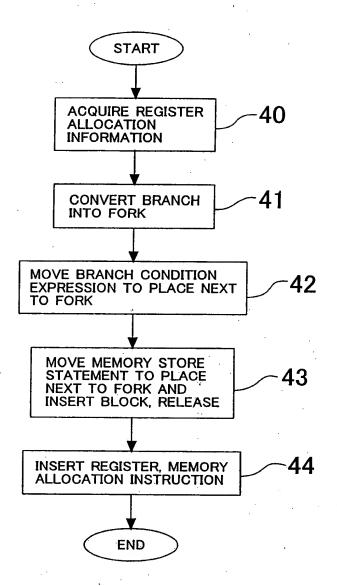


FIG. 4

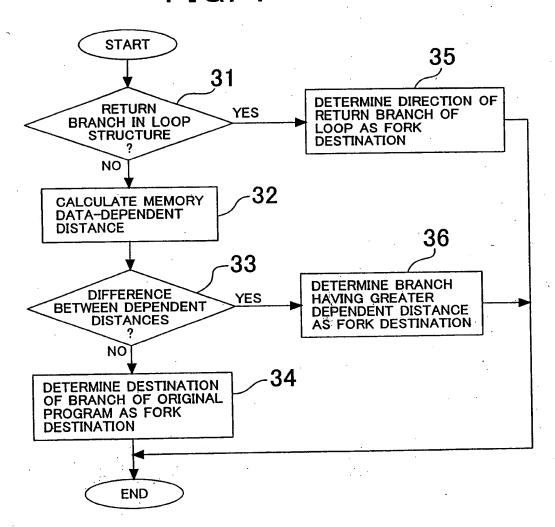


FIG. 6(A)

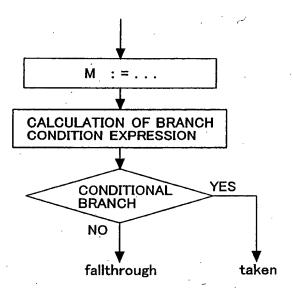


FIG. 6(B)

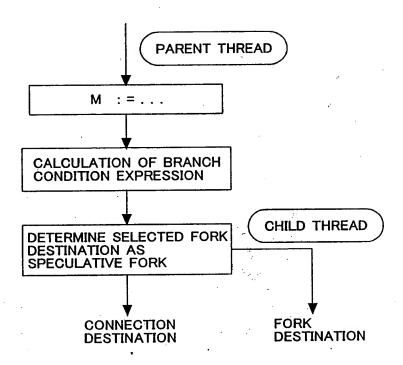


FIG. 6(C)

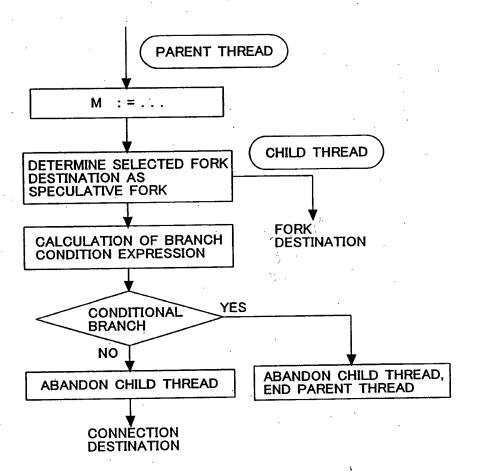


FIG. 6(D)

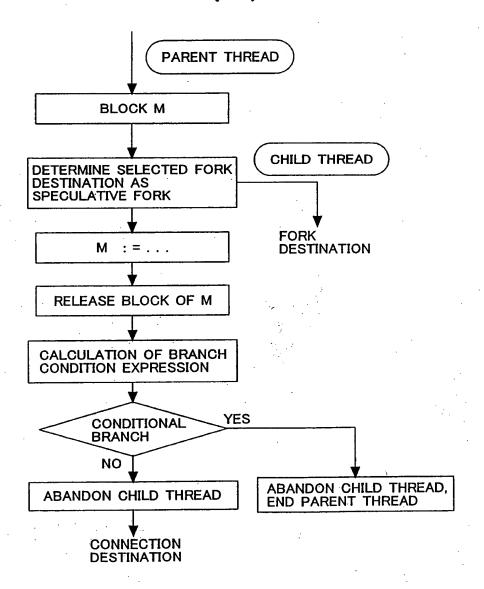
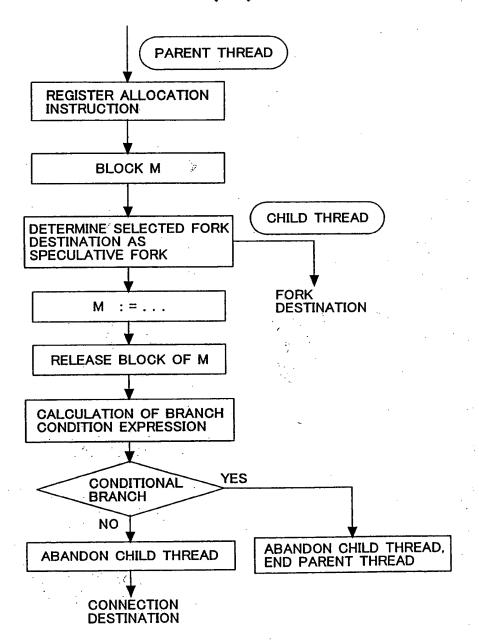


FIG. 6(E)



SPFORK 1	TO CREATE A SPECULATION MODE CHILD THREAD FOR STARTING EXECUTION FROM 1	
TTERM c	TO END SELF THREAD AND SETTLE CHILD THREAD IF C IS TRUE	
FTERM c	TO END SELF THREAD AND SETTLE CHILD THREAD IF C IS FALSE	
THABORT	TO ABANDON A CHILD THREAD OF A SPECULATION MODE	
BLACK m	TO DESIGNATE A MEMORY ADDRESS DESIGNATED WITH M AS BLOCK	
RELEASE m	TO CLEAR BLOCK SET TO MEMORY ADDRESS DESIGNATED WITH M	
DSPIN	TO CREATE A CHILD THREAD CREATED BY SUCCEEDING FORK IN DATA-DEPENDENT SPECULATION MODE	
DSPOUT	TO CLEAR DATA-DEPENDENT SPECULATION MODE OF CHILD THREAD	
RDCL t,	TO INSTRUCT TO ALLOCATE INTERMEDIATE TERMS/ VARIABLES DESIGNATED WITH t , TO REGISTER	
MDCL t,	TO INSTRUCT TO ALLOCATE INTERMEDIATE TERMS/ VARIABLES DESIGNATED WITH t , ··· TO MEMORY	

```
t1 := &X
(1)
(2)
       t2 := I
(3)
       t3 := 4
       t4 := t2 * t3
(4)
(5)
       t5 := t1 + t4
                                     - (B1)
(6)
       t6 := 1
(7)
        mem(t5) := t6
(8)
       t7 := I
       t8 := 20
(9)
        t9 := t7 > t8
(10)
        if false then goto L2
(11)
(12)
       L1:
        t10 := &X
(13)
        t11 := J
(14)
        t12 := 4
(15)
        t13 := t11 * t12
(16)
(17)
        t14 := t10 + t13
                                      (B2)
(18)
        t15 := mem(t14)
(19)
        t16 := J
(20)
        t17 := t15 + t16
(21)
        R := t17
(22)
        goto L3
(23)
       L2:
(24)
        t18 := K
        t19 := 10
(25)
        t20 := t18 / t19
(26)
(27)
        R := t20
(28)
        t21 := &X
(29)
        t22 := J
        t23 := 4
t24 := t22 * t23
(30)
                                      (B3)
(31)
        t25 := t21 + t24
(32)
(33)
        t26 := mem(t25)
(34)
        t27 := R
(35)
        t28 := t26 + t27
        R := t28
(36)
(37)
       L3:
```

FIG. 9

```
(51)
            := &X
        t1
(52)
        t2 := I
(53)
        t3 := 4
        t4 := t2 * t3
(54)
        t5 := t1 + t4
(55)
(56)
        t6 := 1
        mem(t5) := t6
(57)
                                       - (B1)
        SPFORK L2
(58)
(59)
        t7 := I
       t8 := 20
(60)
       t9 := t7 > t8
(61)
(62)
        FTERM
        THABORT
(63)
        goto L1
(64)
(65)
       L1:
(66)
       t10 := &X
(67)
       t11 := J
(68)
       t12 := 4
(69)
       t13 := t11 * t12
(70)
       t14 := t10 + t13
                                       (B2)
(71)
       t15 := mem(t14)
       t16 := J
(72)
       t17 := t15 + t16
(73)
       R := t17
(74)
(75)
       goto L3
(76)
       L2:
       t18 := K
(77)
       t19 := 10
(78)
       t20 := t18 / t19
(79)
(80)
        R := t20
(81)
       t21 := &X
(82)
       t22 := J
                                       - (B3)
       t23 := 4
(83)
(84)
       t24 := t22 * t23
(85)
       t25 := t21 + t24
       t26 := mem(t25)
(86)
(87)
       t27 := R
       t28 := t26 + t27
(88)
(89)
       R := t28
(90)
       L3:
```

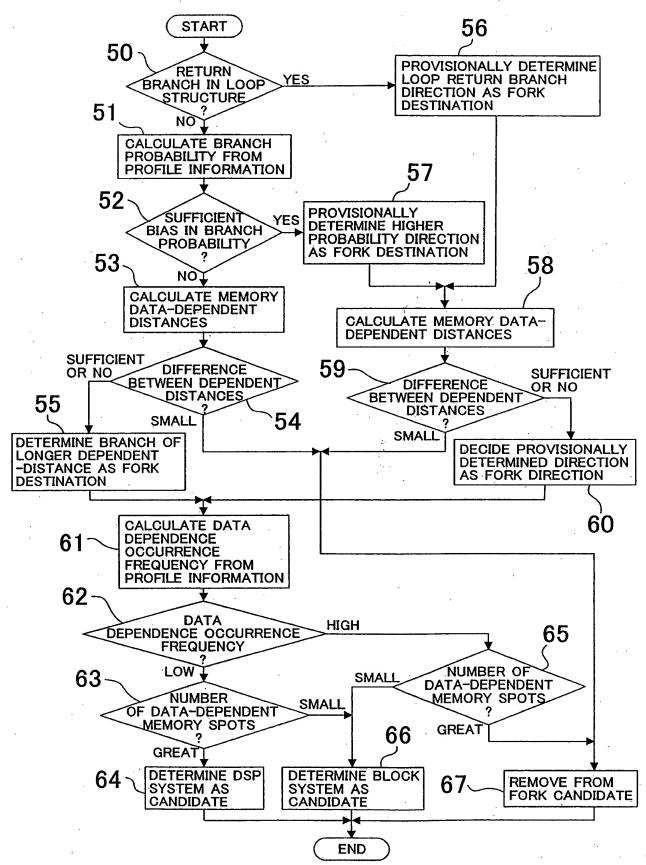
FIG. 10

```
t1 := &X
t2 := I
t3 := 4
(101)
(102)
(103)
(104)
        t4 := t2 * t3
        t5 := t1 + t4
(105)
        BLOCK t5
(106)
        SPFORK L2
(107)
        t6 := 1
(108)
                                      ≻ (B1)
        mem(t5) := t6
(109)
        RELEASE t5
(110)
        t7 := 1
(111)
        t8 := 20
(112)
        t9 := t7 > t8
(113)
        FTERM
(114)
        THABORT
(115)
        goto L1
(116)
(117)
        L1:
        t10 := &X
(118)
        t11 := J
(119)
        t12 := 4
(120)
        t13 := t11 * t12
(121)
        t14 := t10 + t13
(122)
                                       (B2)
        t15 := mem(t14)
(123)
(124)
        t16 := J
        t17 := t15 + t16
(125)
        R := t17
(126)
        goto L3
(127)
(128)
        L2:
(129)
        t18 := K
         t19 := 10
(130)
        t20 := t18 / t19
(131)
         R := t20
(132)
        t21 := &X
(133)
         t22 := J
(134)
                                       - (B3)
         t23 := 4
(135)
         t24 := t22 * t23
(136)
         t25 := t21 + t24
(137)
         t26 := mem(t25)
(138)
         t27 := R
(139)
         t28 := t26 + t27
(140)
(141)
         R := t28
(142)
        L3:
```

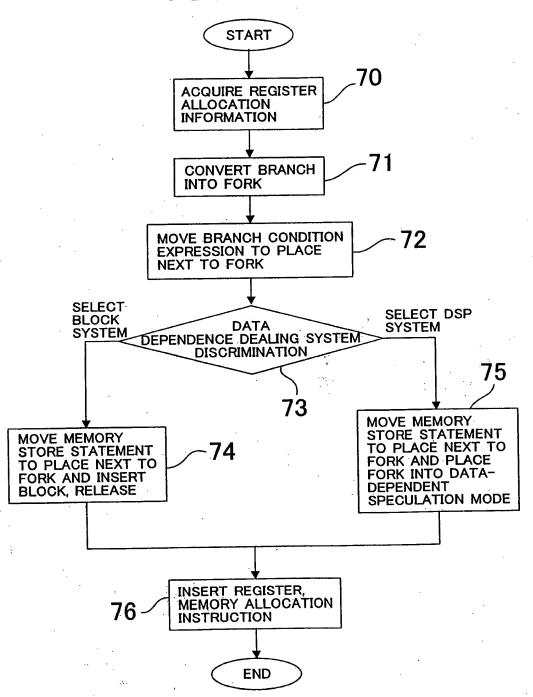
```
RDCL t1 - t9
(201)
        RDCL I
(202)
(203)
        MDCL X
        t1 := &X
(204)
       t2 := I
(205)
        t3 := 4
(206)
        t4 := t2 * t3
(207)
        t5 := t1 + t4
(208)
        BLOCK t5
(209)
(210)
        SPFORK L2
                                    > (B1)
(211)
        t6 := 1
        mem(t5) := t6
(212)
        RELEASE t5
(213)
        t7 := 1
(214)
        t8 := 20
(215)
        t9 := t7 > t8
(216)
(217)
        FTERM
        THABORT
(218)
        goto L1
(219)
       L1:
(220)
        RDCL t10 - t17
(221)
        RDCL R
(222)
        MDCL X, J
(223)
        t10 := &X
(224)
        t11 := J
(225)
        t12 := 4
(226)
                                     - (B2)
        t13 := t11 * t12
(227)
        t14 := t10 + t13
(228)
        t15 := mem(t14)
(229)
(230)
        t16 := J
        t17 := t15 + t16
(231)
        R := t17
(232)
        goto L3
(233)
       L2:
(234)
        RDCL t18 - t28
(235)
        RDCL R
(236)
        MDCL X, J
(237)
        t18 := K
(238)
        t19 := 10
(239)
        t20 := t18 / t19
(240)
        R := t20
(241)
        t21 := &X
(242)
                                     (B3)
        t22 := J
(243)
(244)
        t23 := 4
(245)
        t24 := t22 * t23
        t25 := t21 + t24
(246)
        t26 := mem(t25)
(247)
        t27 := R
(248)
        t28 := t26 + t27
(249)
        R := t28
(250)
        L3:
(251)
```

```
r21 := &X
(255)
        r22 := r11
(256)
(257)
        r23 := 4
        r24 := r22 * r23
(258)
        r25 := r21 + r24
(259)
        BLOCK r25
(260)
(261)
        SPFORK L2
(262)
        r26 := 1
        mem(r25) := r26
(263)
(264)
        RELEASE r25
(265)
        r27 := r11
        r28 := 20
(266)
        r29 := r27 > r28
(267)
(268)
        FTERM r29
(269)
        THABORT
(270)
        goto L1
(271)
       L1:
(272)
        r20 := &X
(273)
        r21 := mem(&J)
        r22 := 4
(274)
        r23 := r21 * r22
(275)
        r24 := r20 + r23
(276)
        r25 := mem(r24)
(277)
(278)
        r26 := mem(&J)
(279)
        r27 := r25 + r26
        r12 := r27
(280)
        goto L3
(281)
(282)
       L2:
(283)
        r20 := r13
        r21 := 10
(284)
(285)
        r22 := r20 / r21
(286)
        r12 := r22
        r23 := &X
(287)
        r24 := mem(&J)
(288)
        r25 := 4
(289)
        r26 := r24 * r25
(290)
        r27 := r23 + r26
(291)
        r28 := mem(r27)
(292)
        r29 := r12
(293)
        r30 := r28 + r29
(294)
(295)
        r12 := r30
        L3:
(296)
```









```
t1 := P
     t2 := 0
                                 (B11)
     t3 := t1 < t2
     if false goto L2
L1:
     t4 := 0
                                 (B12)
     p := t4
L2:
     t5 := P
     t6 := 15
t7 := t5 > t6
                                 (B13)
     if false goto L4
L3:
     t8 := 0
                                 (B14)
     p := t8
L4:
     t9 := 1
     t10 := P
     t11 := t9 << t10
      J := t11
     t12 := Z
     mem (t12) := t11
     t13 := &X
     t14 := P
     t15 := 4
     t16 := t14 * t15
     t17 := t13 + t16
     t18 := mem(t17)
                                 (B15)
     t19 := J
     t20 := t18 + t19
      mem(t17) := t20
     K := t20
     t21 := &X
      t22 := P
      t23 := 4
      t24 := t22 * t23
     t25 := t21 + t24
     t26 := mem(t25)
     t27 := 9
      t28 := t26 > t27
      if false goto L6
L5:
      t29 := &X
      t30 := P
      t31 := 4
      t32 := t30 * t31
                                 - (B16)
      t33 := t29 + t32
      t34 := mem(t33)
      t35 := 1
      t36 := t34 - t35
      mem(t33) := t36
L6:
      t37 := &Y
      t38 := P
      t39 := 4
      t40 := t38 * t39
                                 - (B17)
      t41 := t37 + t40
      t42 := mem(t41)
      t43 := K
      t44 := t42 + t43
      J := t44
```

FIG. 16(A)

BRANCHING NUMBER

B 11	B 12: 2D	B 13: 18D
B _I 3	B 14: 3D	B 15: 17D
B 15	B 16: 3D	B 17: 17D

FIG. 16(B)

MEMORY DATA DEPENDENCE

B 15 → B 16	I2D
B 15 → B 17	4

FIG. 17

```
RDCL t1 - t3
                                                t18 := mem(t17)
      SPFORK L2
                                                t19 := J
      t1 := P
                                                t20 := t18 + t19
      t1 := 0
                                                mem(t17) := t20
                                 (B11)
      t3 := t1 < t2
                                                K := t20
      FTERM t3
                                                DSPOUT
      THABORT
                                                t21 := &X
     goto L1
                                                t22 := P
                                                                               (B15)
                                                t23 := 4
t24 := t22 * t23
t25 := t21 + t24
L1:
      RDCL t4, P
                                 (B12)
      t4 := 0
      P := t4
                                                t26 := mem(t25)
L2:
                                                t27 := 8
      RDCL t5 - t7
                                                t28 := t26 > t27
      SPFORK L4
                                                FTERM t29
      t5 := P
                                                goto L5
     t6 := 15
                                 (B13)
                                          L5:
      t7 := t5 > t6
                                                RDCL t29 - t36, P
      FTERM t7
                                                MDCL X
      THABORT
                                                t29 := &X
                                                t30 := P
t31 := 4
      goto L3
L3:
                                                                               (B16)
                                                t32 := t30 * t31
      RDCL t9, P
                                 (B14)
      t8 := 0
                                                t33 := t29 + t32
      P := t8
                                                t34 := mem(t33)
L4:
                                                t35 := 1
     RDCL t9 - t28 , J , P MDCL K , X , Z
                                                t36 := t34 - t35
                                                mem(t33) := t36
      t9 := 1
                                          L6:
     t10 := P
                                                RDCL t37 - t47, J, P
     t11 := t9 << t10
                                                MDCL K, Y, Z
t37 := &Y
      J := 111
      DSPIN
                                                t38 := P
      SPFORK L6
                                - (B15)
                                                t39 := 4
                                                t40 := t38 * t39
t41 := t37 + t40
      t12 := &Z
      mem(t12) := t11
                                                                               (B17)
      t13 := &X
                                                t42 := mem(t41)
      t14 := P
                                                t43 := K
      t16 := t14 * t15
                                                t44 := t42 + t43
      t17 := t13 + t16
                                                t45 := &Z
                                                t46 := mem(t45)
                                                t47 := t44 + t46
                                                J := t47
```

FIG. 18

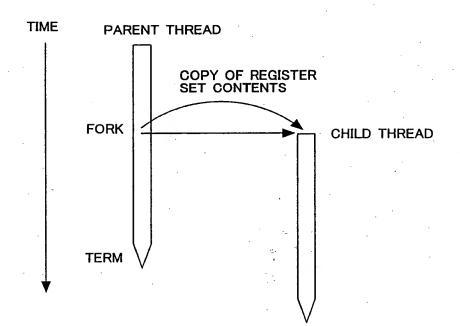


FIG. 19

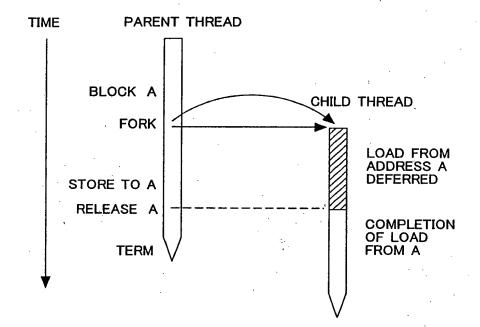


FIG. 20(A)

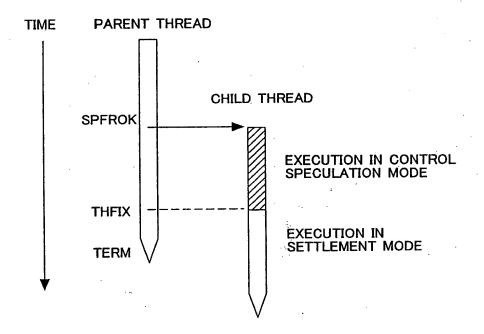


FIG. 20(B)

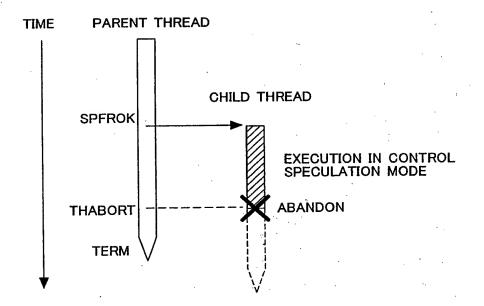


FIG. 21

